

REMARKS

By this Amendment, claims 7-10 have been amended. Thus, claims 1-10 remain pending in the present application.

Applicant acknowledges with appreciation the Examiner's indication of allowable subject matter in dependent claim 7. Applicant submits, however, that claims 1-6 and 8-10 are also patentably distinguishable over the prior art of record, as explained below.

Claims 1, 2, 3, 4, 6 and 8 have been rejected under 35 U.S.C. § 102(e) as being anticipated by Lin, U.S. Patent No. 6304,440 B1. Also, claims 5, 9 and 10 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Lin in view of Lin, U.S. Patent No. 6,304,440 B1.

Lin issued as a patent on June 26, 2001, and can only be relied upon as prior art in the U.S. as far back as its U.S. filing date of August 18, 1999, which is after the June 24, 1999 filing date of Japanese Patent Application No. 11-177730, to which priority is claimed in the present application.

To eliminate Lin as prior art against the present application, therefore, Applicant submits herewith a verified translation of the priority document to thereby perfect the claim for priority.

Since Lin does not constitute prior art against the present application, withdrawal of the rejections is respectfully requested.

As all of pending claims 1-10 have been demonstrated to be allowable over the prior art of record, Applicant further submits that the present application is currently in condition for allowance. Early and favorable reconsideration in this regard is courteously solicited.

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Respectfully submitted,

By 

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APPENDIX B
VERSION WITH MARKINGS TO SHOW CHANGES MADE
37 C.F.R. § 1.121(b)(iii) AND (c)(ii)

PORTABLE INFORMATION RADIO TERMINAL DEVICE
AND MANUFACTURING METHOD THEREOF

BACKGROUND OF THE INVENTION

5 Field of the invention

The present invention relates generally to a portable information radio terminal device or a personal digital assistance (PDA) and a manufacturing method thereof. More particularly, the invention relates to a portable information
10 radio terminal device and a manufacturing method thereof, which can effectively prevent peeling off, breakage or so forth of
^{an} electrical connecting portion of an electronic parts^g mounted on a printed circuit board in a device casing.

Description of the Related Art

15 Conventionally, as shown in Figs. 3A and 3B, a printed board 12 incorporated in a portable information radio terminal device 11 is secured in a device casing by screws 15 and bosses 17. Accordingly, when an impact is exerted on the portable information radio terminal device 11, portions^{of the printed circuit board 12} secured by the
20 screws cannot ~~follow with vibration or deflection of the printed circuit board 12 caused by exertion of the impact to cause stress~~^{vibrate or deflect in response to}
~~concentration~~^{to concentrate} about the portions secured by the screws to amplify^{the} vibration or deflection of the printed board 12. As
a result, peeling can be caused in^a solder ball (electrical
25 connecting portion) of a chip size package (CSP) mounted on

the printed board 12.

In Japanese Unexamined Utility Model Publication No. Showa 58-162689, the following technology has been disclosed. Disclosed in the above-identified publication is a printed board support structure of an electronic equipment, in which a printed board mounting a printed wiring and various parts, such as relays and so forth, is rigidly fixed in a casing. Elastic engaging projections are projected from a printed board mounting surface of the casing. Also, ^{an} auxiliary projections are projected in opposition to the elastic engaging projections across the printed board with a distance. In the printed board, engaging holes to engage with the engaging projections are formed for forming the supporting structure of the printed board of the electronic equipment. On the other hand, between each of ^{the} supporting portions of the casing and the printed board, ^{an} elastic member, such as rubber member is disposed within a space portion for accommodating tolerance.

On the other hand, in Japanese Unexamined Patent Publication No. Heisei 8-23181, the following technology has been disclosed. A circuit board has a structure to be tightly clamped by first and second rollers. When the circuit board is inserted between the first and second rollers, the first and second rollers are rotated in a board inserting direction by a frictional force. With such construction, vibration ^{is} ~~to~~ be caused in the equipment casing ^{are} ~~is~~ absorbed to protect the

circuit board from vibration. Furthermore, the circuit board can be smoothly inserted into the casing.

It is desirable to maintain electrical connection of the electronic ^{parts} ~~pats~~ mounted on the board in the device body when the portable information ^{radio} ~~ratio~~ terminal device is subject to an impact (external force) due to ^{the device being dropped} ~~falling down~~ or so forth. It is also desired that large vibration ^{-S} and/or impact ^{will} not be transmitted to the electronic parts within the device body to maintain electrical connection of the electronic parts and ^{to} thus not ^{be} a cause of failure of the electronic parts.

Also, it is desired to ^{be able to} easily produce the portable information radio terminal device ^{to be} resistant against ^{such an} ~~the~~ impact ^{as} set forth above.

SUMMARY OF THE INVENTION

15 It is therefore an object of the present invention to provide a portable information radio terminal device or personal digital assistance (PDA) which can maintain electrical connection of electronic ^{parts} ~~pats~~ mounted on ^a ~~the~~ board in a device body when the portable information ^{radio} ~~ratio~~ terminal device is subject to an impact (external force) due to ^{the device being} ~~falling~~ ^{dropped} down or so forth.

Another object of the present invention ^{is} to provide a portable information radio terminal device, in which large vibration ^{-S} and/or impact will not be transmitted to the ^{to} electronic parts within the device body to maintain electrical

connection of the electronic parts and thus not ~~to be~~^{not} a cause
of failure of the electronic parts.

A further object of the present invention is to provide
a manufacturing method to easily manufacture the portable
5 information radio terminal device ^{to be} resistant against ^{such an} the impact as
set forth above.

According to ^a the first aspect of the present invention,
a portable information radio terminal device comprises:

a device body;
10 an electronic part provided in the device body; and
an elastic member supporting the electronic part within
the device body.

According to ^a the second aspect of the present invention,
a portable information radio terminal device comprises:

15 a device body;
a printed board provided in the device body;
an electronic part provided on the printed board; and
an elastic member supporting the printed board within
the device body.

20 In the preferred construction, the device body may
include a first and second casing to be assembled with each
other, and the elastic member may be disposed between the
printed board and the first casing and between the printed board
and the second casing.

25 A direction of an elastic force acting on the printed

board from the elastic member disposed between the printed board and the first casing and a direction of an elastic force acting on the printed board from the elastic member disposed between the printed board and the second casing substantially may match with a direction of assembling the first and second casings.

The elastic body may be pressurized by assembling the first casing and the second casing. It is also possible that the elastic member is provided at only one side of the printed board in the longitudinal direction, ^{while} and the other ^{end} side of the printed board in the longitudinal direction is situated as a free end.

The device body may be divided ^{into} in longitudinal direction into first and second halves, and the elastic member may be provided only on one of the first and second halves where ~~a~~ ^{the} gravity center ^{gravity of} of the portable information radio terminal device is located.

A plurality of elastic members may be provided per ~~one~~ ^a side of the printed board.

According to ^a the third aspect of the present invention, a manufacturing method of a portable information radio terminal device for assembling a first casing and a second casing, and housing a ^{-ed} printing board between the fir^{-st} and second casing^{-s}, comprises:

a step of arranging the printed board on one of the first and second casings via an elastic member; and

a step of assembling the other of the first and second casings to the one of the first and second casing^{-S} with interpositioning^{or} the elastic member between the other of the first and second casings and the printed board.

- 5 Preferably, the first and second casings may be assembled with pressurizing^{or} the elastic member.

The portable information radio terminal device according to the present invention can reduce concentration of stress ~~to be~~ caused in response to an impact upon ~~falling down~~^{dropping the device} or so forth by holding the printed board assembled in the device body by the elastic member^{made with a material}, such as impact absorbing material having ^{an} α high elastic force.

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BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood more fully from the detailed description given hereinafter with reference to the accompanying drawings of the preferred embodiment^{-S} of the present invention, which, however, should not be taken to be ~~limiting~~^{or} ~~limitative~~^{provided} to the present invention, but are ^{for} explanation and understanding only.

15

20 Figs. 1A and 1B show ^a the first embodiment of a portable information radio terminal device according to the present invention, in which Fig. 1A is a front elevation^{-al view}, and Fig. 1B is a ^{cross-} section^{-al view} taken along line A - A of Fig. 1A;

Fig. 2 is a front elevation^{-al view} of a printed board and an elastic body of ^a the second embodiment of a portable information

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radio terminal device according to the present invention; and

Figs. 3A and 3B show ^athe conventional portable information radio terminal device ~~according to the present invention~~ ^{- a view thereof}, in which Fig. 3A is a front elevation, and Fig. 3B is ^{cross - a view} a section taken along line B - B of Fig. 3A.

DESCRIPTION OF THE PREFERRED EMBODIMENT ^S

The present invention will be discussed hereinafter in detail in terms of the preferred embodiment ^{- S} of the present invention with reference to the accompanying drawings. In the following description, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be obvious, however, to those skilled in the art that the present invention may be practiced without these specific details. In other instance ^{- S}, well-known structure are not shown in detail in order to avoid unnecessary ^{- dy} obscurity ^{- ing} of the present invention.

Figs. 1A and 1B show ^athe first embodiment of a portable information radio terminal device according to the present invention, in which Fig. 1A is a front elevation ^{- a view}, and Fig. 1B is ^{cross - a view} a section taken along line A - A of Fig. 1A. As shown in Figs. 1A and 1B, a portable information radio terminal device 1 has a receiver portion 1a, a transmitter portion 1b, a liquid crystal display portion 1c and an operation portion 1d. A printed ^{- in} board 2 assembled with a device body 1H is held through an elastic member 5.

As shown in Fig. 1B, the elastic member 5 is tightly fitted between an upper casing 3 and the printed board 2 and between a lower casing 4 and the printed board 2 without any gap^S under a slightly pressurized condition. If^a gap is present, impact absorbing ability and stress distribution performance^{may} can be lowered.

When the portable information radio terminal device 1 is subject^{-ed} to an impact due to ~~falling down or in other reason,~~^{the device being dropped or some} occurs in which a phenomenon^S to cause large vibration^S and deflection^S of the upper casing 3, the lower casing 4 and the printed board 2 assembled in the device body 1H^{are caused} occurs. At this time, vibration and deflection between the upper casing 3 and the printed board 2 and between the lower casing 4 and the printed board 4 ~~is~~^{are} absorbed by the elastic member 5. Also, since ~~bonding points~~^{bonded to the elastic member 5 at only a} of the elastic member 5 to the printed board is not single^{point}, and the elastic member 5 does not ~~act for~~^{to prevent} fix the printed board against vibration or deflection, stress concentration can be avoided. Accordingly, ~~occurrence~~^{the effects} of large vibration^S on the printer board ~~per se~~ can be reduced. By this, CPSS mounted on the printed board ~~may not~~^{are less likely to} peel off the printed board 2.

As shown in Fig. 1B, the printed board 2 has a^{longitudinal} length of ~~in a longitudinal direction~~^{and is} about half of that of the device body 1H ~~to be~~^{the} arranged at approximately upper half in the longitudinal direction of the device body 1H. On a surface of the printed board 2 opposing to an inner surface of the lower

casing 4, electronic parts, such as CSPs (Chip Size Packages) are mounted.

Among ^{the} components in the portable information radio terminal device 1, ~~a weight of~~ the liquid crystal display portion 1c ^{is} ~~becomes~~ relatively ^{heavy and constitutes} large ~~which can be~~ a large proportion ^{of the} ~~in~~ overall weight of the portable information radio terminal device 1. As shown in Fig. 1A, since the liquid crystal display portion 1c is located ^{in the} ~~at~~ upper side ^{of} half in the longitudinal direction of the device body 1H, ^{the center of} ~~a~~ gravity center of the portable information radio terminal device 1 is located at ^{the} upper side of the center portion in the longitudinal direction. Accordingly, when the portable information radio terminal device 1 ^{is dropped} ~~falls down~~, it inherently falls ^{-S} in the ~~an~~ upside-down ^{orientation such that} ~~attitude~~ ^{is most likely to suffer} ~~collide at~~ the upper side ^{to easily subject} ~~the~~ of the collision ^{to impact}. For this reason, in order to ^{achieve} ~~obtain~~ efficient impact resistance, ^{is held in} ~~a portion holding~~ the printed board 2 ^{by} ~~on~~ the device body 1H with the elastic member 5 ^{positioned} ~~is set~~ at upper side in the longitudinal direction of the portable information radio terminal device 1 and in the vicinity of the uppermost position of the printed board 2.

The printed board 2 is supported only on the side close to the uppermost position thereof to ^{thereby} ~~situate~~ the other end of the printed board 2 in the longitudinal direction as ^a ~~free~~ end. This works together with ^{the} ~~elasticity~~ of the supporting portion (elastic member 5) of the printed board ² ~~to~~ ^{provide an} ~~cause~~ appropriate

degree of elastic deformation in the printed board 2 without causing local stress concentration when ^{an} external force is applied to the portable information radio terminal device 1, ^{thereby} to cancel energy of the external force acting on the printed board 2. Accordingly, stress concentration will not be caused in ^{the} electrical connecting portion of the CSP 6 on the printed board 2 or the CSP per se.

^{The} A contact area of the elastic member 5 with the printed board 2 and ^{the} a contact area of the elastic member 5 with the upper casing 3 or the lower casing 4 are substantially the same ^{size} as each other. The contact area is desired to be as large as possible. By providing ^a large area for supporting the printed board 2 by the elastic member 5, stress is not concentrated when the portable information radio terminal device 1 is subject ^{ed} to ^{an} impact to prevent the printed board from vibrating or deflecting.

As set forth above, the elastic member 5 supporting the printed board 2 abuts with the upper casing 3 and the lower casing 4 of the device body 1H. When the portable information radio terminal device 1 is ^{dropped} fallen down, it tends to fall down to ^{hit} ^{abut} ^{at} onto the ground ^{which is the} from the upper surface of the upper casing 3 ^{panel} to be an operation surface and ^{the} a display surface ^{at the} or from a back surface of the lower casing 4 located on the back side ^{of the device} to easily cause impact. ^{Accordingly} Associating with this, the elastic body 5 abut ^{-S} on the surfaces extending in ^a surface

to that the
front of the
impact occurs

direction of the upper surface and the back surface of the device body 1H ^{so as} in order to enhance ^{its} impact absorbing ability.

Bonding of the elastic member 5 onto the printed board 2 and the upper and lower casings 3 and 4 ^{may be achieved using} ~~is done by~~ various ^{types} of adhesive. In this case, corresponding to a bonding force applied by the adhesive ~~per se~~, ^a clamping force ^{may be exerted} to depress the elastic member 5 onto the printed board 2 from the upper and lower casings 3 and 4 ~~may act~~.

^{They} Material and elastic modules of the elastic member 5 are selected for effectively absorbing ^{on} impact to be exerted onto the portable information radio terminal device 1 upon ~~fallen~~ ^{falling} ~~down~~ ^{during a} from a height ^{supposed} in normal use condition, and to effectively prevent failure of the electronic parts and/or peeling off of the connecting portion.

15 In the embodiment shown in Fig. 1(b), the elastic member 5 is arranged both between the printed board 2 and the upper casing 3 and between the printed board 2 and the lower casing 4. In the shown embodiment, the elastic member 5 ^{composed} ~~is consisted~~ of mutually separate elastic components respectively disposed 20 between the printed board 2 and the upper casing 3 and between the printed board 2 and the lower casing 4. However, instead of forming the elastic member 5 with separated ^{two} elastic components, it is possible to form it with a single elastic component with a cut out portion for receiving the printed board 25 2 therein.

Upon supporting the printed board 2 by an elastic force of the elastic member 5, ^{the} ~~a~~ ^{in which} direction ~~to apply~~ ^{is applied} the elastic force onto the printed board 2 matches with a direction ^{in which} ~~to mating~~ ^{one mated and} and ~~assembling~~ ^{assembled} the upper casing 3 and the lower casing 4 upon

5 manufacturing of the portable information radio terminal device 1 (horizontal direction in Fig. 1B). Accordingly, upon manufacturing of the portable information radio terminal device 1, in the condition where the printed board 2 is placed at a predetermined position on the inner surface of one of the
10 upper casing 3 and the lower casing 4 via the elastic member 5, the other of the upper casing 3 and the lower casing 4 is fitted via the elastic member 5 arranged on the inner surface. By this, ^{process} the elastic member 5 is properly pressurized ~~with each~~ ^{other} with respect to the upper casing 3, the lower casing 4
15 and the printed board 2. In this case, between the upper casing 3 and the lower casing 4, ^{which are} preliminarily molded into predetermined shapes, respectively, the elastic member 5 is disposed to adjust the elastic force of the elastic member 5 acting on the printed board 2 automatically and optimally. This can be achieved
20 either in the case where the elastic member 5 is formed ~~with~~ ^{as} separated ^{two} elastic components or in the case where the elastic member 5 is formed ^{as} ~~with~~ ^{component having a} one elastic member ~~with the~~ cut out portion.

On the other hand, while not illustrated in the drawings,
25 the elastic member 5 can be provided only on one side between

the printed board 2 and the upper casing 3 and between the printed board 2 and the lower casing 4.

Also, the printing^{-ed} board 2 is^{supported} in^a cantilever^{support} arrangement in which it is^{only at} ~~condition as being supported on one end~~ ^{thereof} portion in the

5 longitudinal direction of the printed board 2 (but is supported ~~with~~^{along a} wide contact surface) in the shown embodiment. However, it is also possible to support the elastic member 5 at both ends in the longitudinal direction.

Next, ^athe second embodiment of the present invention will
10 be discussed with reference to Fig. 2.

As shown in Fig. 2, the elastic members 5 are arranged in the vicinity of the CSP^{-S} 6 mounted on the printed board 2 and are bonded at a plurality of ^{-S}positioned on the printed board 2. Among a plurality of elastic members 5, ^{some}part of the elastic
15 members 5 are arranged on both end portions in the longitudinal direction of the printed board 2. The other^{-S} part of the elastic members 5 are arranged in extension along the outer edge portion^{-S} of the substantially quadrangular shaped CSPs 6.

In the embodiment shown in Fig. 2, a ratio of total contact
20 area of a plurality of^g (five in the embodiment shown in Fig. 2) of elastic members 5 provided on the surface 2a ~~and the~~
~~surface 2a~~ versus the area of the surface 2a on the side of the printed board where the CSPs 6 are mounted, is about 7.5%.

It is also desirable to bond a plurality of elastic members
25 ⁵ even on the back surface of the surface 2a of the printed

To achieve effective
board 2. ~~In view of~~ stress distribution or impact absorption,
it is desirable to bond the elastic members 5 on ^{the} back sides
of the printed board in a ratio of area greater than or equal
to 5%. Furthermore, the elastic members 5 provided at a
5 plurality of positions on both ^{front} of the surface and back sides
of the printed board 2 can be provided at corresponding
positions of the ^{front} surface side and the back side, respectively.
In the alternative, it is also possible to provide the elastic
members 5 at mutually offset positions on the surface side and
10 the back side of the printed board 2.

In the shown embodiment of the portable information radio
terminal device 1, by holding the printed board 2 assembled
in the device body 1 with the elastic members 5 ^{made} of impact
absorbing material, ~~it can prevent~~ solder balls of the CSPs
15 and the like mounted on the printed board 2 ^{can be prevented} from breaking or
peeling due to vibration or deflection of the printed board
2 in response to ^{the force} ~~exertion~~ of the impact ^{caused the device being dropped} by ~~falling down~~ or other
reason.

In particularly ², in the embodiment shown in Figs. 1A and
20 1B, the printed board ² assembled in the portable information
radio terminal device 1 is held by the elastic member 5 ^{made of a material}, such
as ^{an} impact absorbing material, ~~disposed~~ between the upper casing
3 and the lower casing 4. By this, ^{arrangement} ~~the stress to be~~ exerted
upon receiving ^{an} impact due to ^{the device being dropped} ~~falling down~~ or so forth, will
25 not be concentrated ^{at a} ~~to the one~~ fixed point and be distributed

to prevent the printed board 2 from causing significant vibration or deflection. Furthermore, as shown in Fig. 2, the effect can be further enhanced by bonding the elastic members 5 to a plurality of ^{locations} ~~portions~~.

5 It should be noted that while the shown embodiments ^{are} ~~take~~ ^{constructed} ~~constructions~~ to support the printed board 2 by the elastic member or members 5 disposed between the upper casing and the printed board 2 and/or between the lower casing and the printed board 2, the present invention should not be limited to a
10 construction where the printed board 2 is supported only by the elastic member or members 5. When an external force, such as ^{an} impact upon ^{being dropped} ~~falling down~~ or the like, is exerted on the portable information radio terminal device 1, the printed board 2 is supported at a plurality of positions or with a relatively
15 large area or at a displaceable point so as to distribute the stress to a plurality of positions or to a wide region in order to avoid stress concentration ^{at} ~~to~~ ^{location} ~~position~~. Therefore, stress can be distributed.

With the embodiments set forth above, one effect is to
20 solve the problem of breakage or peeling off of the CSPs mounted on the board. Therefore, ^{the} influence of ^{an} ~~falling down~~ impact ^{from dropping} ~~of~~ the portable telephone can be reduced. The reason is that, by holding the printed board with the elastic member without using ^{any} screw, ^{is} a portion supporting the printed board becomes wider
25 to avoid concentration of the stress upon exertion of ^{an} impact,

by dropping the device
such as ~~falling down~~, to prevent vibration or deflection of
the printed board.

It should be noted that what is supported by the elastic
member is not limited to the printed board but can be various
5 boards ^{on which} ~~mounting the~~ ^{one mounted} ~~electronic parts~~ ^{an} or can be ^{other} ~~the~~ electronic
part per se.

With the portable information radio terminal device
according to the present invention, electrical connection of
the electronic parts mounted on the board in the device body
10 can be maintained even upon exertion of ^{an} impact (external force)
due to ^{dropping} ~~falling down~~ of the portable information radio terminal
device to minimize ^{the} ~~possibility of~~ ^{an} occurrence of failure of the
electronic parts.

Although the present invention has been illustrated and
15 described with respect to exemplary embodiments thereof, it
should be understood by those skilled in the art that the
foregoing and various changes, ^O ~~emission~~ ^{-S} and additions may be
made therein and thereto, without departing from the spirit
and scope of the present invention. Therefore, the present
20 invention should not be understood as limited to the specific
^{-S described} ~~embodiment set out~~ above but to include all possible embodiments
which can be embodied within ^{the} ~~a~~ scope encompassed ^{by} and equivalent ^{-S}
~~thereof with respect to~~ ^{of} ~~the feature~~ ^{-S forth} set out in the appended
claims.

APPENDIX B
VERSION WITH MARKINGS TO SHOW CHANGES MADE
37 C.F.R. § 1.121(b)(ii) AND (c)(i)

SPECIFICATION:

Attached hereto is a marked copy of the original specification showing the changes made.

CLAIMS:

7. (Amended) A portable information radio terminal device as set forth in claim 1, wherein said device body is divided in the longitudinal direction into first and second halves, and said elastic member is provided only on one of said first and second halves where a center [gravity] of gravity of said portable information radio terminal device is located.

8. (Amended) A portable information radio terminal device as set forth in claim 2, wherein a plurality of elastic members are provided per [one] side of said printed board.

9. (Amended) A [manufacturing] method of manufacturing a portable information radio terminal device for assembling a first casing and a second casing, and housing a [printing] printed board between said [fir] first and second [casing] casings, comprising:

a step of arranging said printed board on one of said first and second casings [via] with an elastic member positioned between said printed board and said one of said first and second casings to support said printed board; and

a step of assembling the other of said first and second casings to said one of said first and second [casing with] casings while interpositioning said elastic member between said [the] other of said first and second casings and said printed board.

10. (Amended) A [manufacturing] method of manufacturing a portable information radio terminal device as set forth in claim 9, wherein said elastic member is pressurized upon assembling said first and second casings [are assembled with pressurizing said elastic member].